Malaria Detection Using Low-Resolution Microscopes with Deep Learning
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**PREDICTING**

**Motivation:** Malaria affects 200 million humans.

**What we built**
- We observe blood samples using low-resolution microscopes
- We segment red blood cells (RBC) using deep learning
- We use the RBC segmentation to detect malaria parasites.

**Results**
- Red blood cells segmentation achieves a recall of 0.73.
- It improves malaria classification by an order of magnitude: AUC of 99.998%

**DATA**

- **Red Blood Cell Segmentation**
  - **Input Image**
  - **Segmentation Mask**

  820x820x3 cropped to 128x128x3

**Labeling:** Automatic with Hough Transform, very noisy

**Contribution:** Data augmentation on train data to reduce noise in train labels

**Splits:** 12,000 train / 1,500 val / 1,500 test images

**MODELS**

- **Architecture Search:** U-Net [1], Fully Convolutional DenseNets [2]
- **Hyperparameter Tuning:** learning rate, number of layers

**APPLICATION – LEVERAGING OUR RED BLOOD CELL (RBC) SEGMENTATION TO DETECT MALARIA PARASITES**

<table>
<thead>
<tr>
<th>Goal: We classify “malaria parasites vs platelets”, in fluorescent images, using LDA</th>
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<tbody>
<tr>
<td>malaria vs platelet</td>
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**Hypothesis:** Malaria classification improves if we add RBC segmentation as a feature

**Result:** Malaria classification improves by an order of magnitude using our RBC segmentation!

**Test AUC=99.998% vs Test AUC=99.98%**

**RESULTS – RED BLOOD CELL (RBC) SEGMENTATION**

<table>
<thead>
<tr>
<th>Test IoU</th>
<th>Test Recall</th>
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<tbody>
<tr>
<td>NA</td>
<td>NA</td>
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<tr>
<td>0.65</td>
<td>0.40</td>
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<tr>
<td>0.72</td>
<td>0.55</td>
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<tr>
<td>0.70</td>
<td>0.73</td>
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**DISCUSSION**

- Automatic labels for RBC segmentation were initially very noisy. Data augmentation and pixel weights led to excellent RBC segmentation
- This is the first work to tackle automatic malaria diagnosis using low-resolution, cheap microscopes
- It paves the way to detecting malaria in areas with constrained access to medical infrastructure and medical expertise

**REFERENCES**


**FUTURE WORK**

- Deploy the RBC segmentation & the malaria detection on portable chips
- Replace LDA classification with neural network classification